Low Cost Composite Processing Methods May Revolutionize Prototype Manufacturing

Payoff

Low Cost Composite Processing (LCCP) centered on non-autoclave processable materials technology has effectively demonstrated a tremendous potential for improving the affordability of composite structures for aerospace and automotive applications. Continuing research in these areas could lead to dramatic cost savings in the future through increased freedom to design large, complex, unitized structures and decreased tooling costs.

Accomplishment

Research conducted by the Materials and Manufacturing Directorate (ML) led to the development and technology transfer of LCCP methods that use lightweight aerospace composite materials based on resins that can be cured at temperatures much lower than those used for conventional composite materials. The result is a major reduction in the cost of applying organic matrix composites to aerospace structures by eliminating the requirement to process parts in autoclaves. Autoclave processing typically utilizes high temperatures and pressures and requires expensive and long lead-time autoclave hardened tooling.

Background

There has been an increasing trend in aerospace and defense industries to reduce the costs of parts manufacturing, even during low-volume production, while producing components of technically superior quality. This trend is especially noticeable in the composites manufacturing sector, where non-recurring costs, such as design and production of prototypes, can tend to be quite high and especially for low production volumes. As a result, conventional approaches to prototyping are being replaced with emerging rapid prototyping technologies, as well as, the production of cost-effective, fully working "real" prototype systems which can be used as technology demonstrators. For many working prototypes and technology demonstrators, composite materials are required to obtain the desired performance goals, yet cost and time constraints limit the use of traditional autoclave-processed composite materials. For other prototypes, composite materials enable innovative design and manufacturing features. In a collaborative effort with defense and aerospace companies, ML helped develop advanced structural composite materials designed to be processed at temperatures as low as 60° C, as opposed to traditional materials processed at 177° C, thereby eliminating the requirement for autoclave processing and associated expensive tooling. The Directorate's research with Boeing, St. Louis, under the LCCP program, enabled a 40 percent reduction in fabrication cost for a composite aircraft wing using non-autoclave processing versus conventional processing. Expanded research in non-autoclaving processing technologies could lead to the successful production of large, complex one-piece composite structures but without the size, thermal constraints and tooling costs associated with autoclaves.